Studies on Myelin Formation & Particulate growth in Mixed Surfactant System

Project Report

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By

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DECLARATION

I, **Sushree Sabinaya,** do hereby declare that the research work incorporated in the report entitled "**Studies on myelin formation and particulate growth in mixed surfactant system"** is an authentic work carried out by me under the supervision of **Dr G .Hota**, Department of Chemistry, **National Institute of Technology Rourkela (NITR), Rourkela**. The present work or any other part thereof has not been presented to any other University or Institution for the award of any other degree regarding to my belief.

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CERTIFICATE

This is to satisfy that the thesis entitled ***"STUDIES ON MYELIN GROWTH & PARTICULATE FORMATION IN MIXED SURFACTANT SYSTEM"*** being submitted by **Ms. Sushree Sabinaya** (Roll No. 409CY2026) for the partial fulfillment of the requirements for the award of M.Sc. degree in Chemistry at the National Institute of Technology, Rourkela, is an authentic work carried out by her under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University or Institute for the award of a degree or diploma.

N.I.T Rourkela

05 May'2011

Supervisor

Dr.Garudadhwaj Hota

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ABSTRACT

Surfactant behavior on dissolution in water is an interesting phenomenon resulting in the formation of various non equilibrium microstructures. Our study is based on one of these non equilibrium structures well known as myelin. Myelin is formed when sparingly water soluble surfactants come in contact with water. In this report the myelin formation & structure in mixed surfactant system has been investigated with the help of digital video microscopy. It is shown that myelin growth is slower in mixed surfactant system as compared to the single surfactant system.

INTRODUCTION

The dynamic aspects of non equilibrium microstructures have drawn considerable attention in the recent years. Several research groups have investigated the interfacial instabilities extensively. These studies could be useful for potential applications in the field of nanotechnology & biomedical science these unusual phenomenons was first observed by Dr Rudolf Virchow in 1854 & since then it has been an area of active interest [1]. Myelin are highly viscous, gel-like, microstructures consisting of elongated tubules composed of concentrically stacked multi lamella formed with water and insoluble surfactants.[2] These kinds of growth are observed when complex fluids which are not in equilibrium state progresses towards equilibrium causing instabilities. Such instabilities are exhibited only when the lamellar phase is nearly insoluble in excess solvent and has a large miscibility gap with a phase comprising almost pure water [3-7]. These are named myelin because of the structural similarities with myelin sheath of nerve cells.

Mixed surfactant systems are now a day widely used in nearly all practical applications of surfactants. The most important fact is there is an advantage of performance or synergism when we deliberately mix different surfactant as compared to their single counterparts [8]. When surfactants are added together in water, physicochemical properties are altered, which may be because of the net interaction between the amphiphiles, or in other words we can say that there is non-ideal mixing [9].

In this report, we have studied the myelin formation and growth by mixing two water insoluble surfactants i.e AOT & PC system. Apart from this, we have also used the non equilibrium myelin structure of mixed surfactant system as a model system to carry out the precipitation reaction and formation of calcium phosphate particles.

RESEARCH OBJECTIVE

1. To study the growth and formation of myelin structure in mixed surfactant system using AOT/PC/water system.
2. To study the effect of surfactant concentration on stability & formation of myelin structure.

3. To compare the growth of the mixed system with single AOT/water system.

EXPERIMENTAL SECTION

MATERIALS

We have used the following chemicals without further purification for this experimental works.

The surfactants AOT [sodium bis (2-ethylhexyl) sulfosuccinate] was purchased from Sigma, with 99% purity, Chloroform AR grade from Merck (India), calcium chloride from Merck India Ltd, sodium phosphate AR grade from S.D Fine, India. Throughout all the experiments doubly distilled water was used. Cleaned and dry glass slides and cover slip were used for the experimental works.

METHODS

Three sets of stock solutions were prepared. The first one was of AOT in chloroform , the second one was PC in chloroform & the third stock was made by mixing equimolar concentration of both AOT & PC.A drop of this solution was taken on the glass slide. After the evaporation of solvent, a round cover slip was gently pressed onto the dry surfactant droplet & myelin growth was observed when surfactant phase was contacted with a drop of water. Myelin growth kinetics was observed using an optical microscope. The concentration of the stock solutions was varied between 0.2M to 0.5M.

RESULTS & DISCUSSION

The varying growth & structures of myelin have been reported by different groups and it has been established that these growths are an outcome of back flow of water and dissolution process (Buchnan et.al 2000). A similar mechanism is observed in our case also. After an initial delay, formation of simple cylindrical rod like structures were observed which gradually elongated with increasing time. The growth was then quantitatively analyzed by measuring distance between the myelin roots and myelin fonts at different time intervals. Fig 1.1 shows the growth of myelin formed by mixed surfactant system at different times. To get a better precision several lengths were averaged to get a mean growth of myelin. The square of the average length (L^2) has been plotted with corresponding time of all the systems examined.

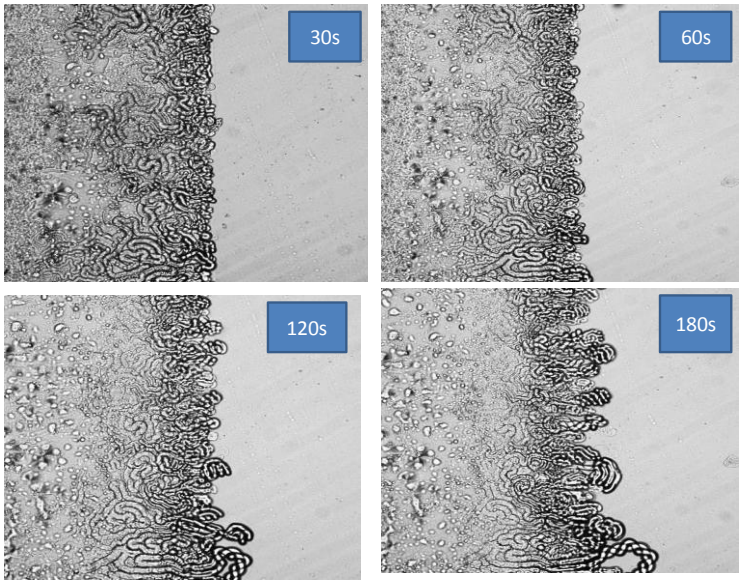

Fig. 1: Myelin growth w.r.t time in 0.3M mixed (AOT & PC)/H_2O system

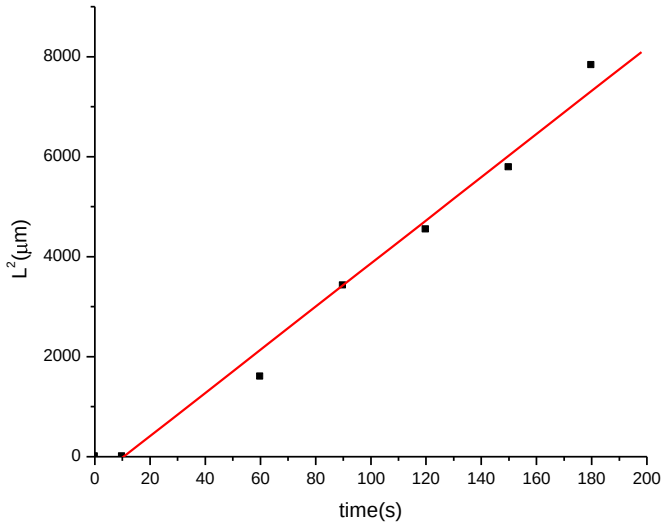

Fig.2: Plot of L^2 vs time of mixed (AOT/PC)/H_2O 0.3M

From the figures it is clear that the curve is approximately linear and a best fit straight line is obtained. It indicates that the myelin growth in mixed surfactant system follows approximately the same order as that of individual system. A striking dissimilarity is observed in the duration of initial delay before the appearance of myelin. While it is about 4 to 5 seconds in the single system, in the mixed system it is about 10 seconds.

Effect of surfactant concentration on myelin growth

We have also studied the effect of surfactant concentration on the growth behavior of myelin. We have varied the AOT concentration & the mixed surfactant concentration from 0.2M to 0.5M. Fig4. Shows the growth pattern at different concentrations

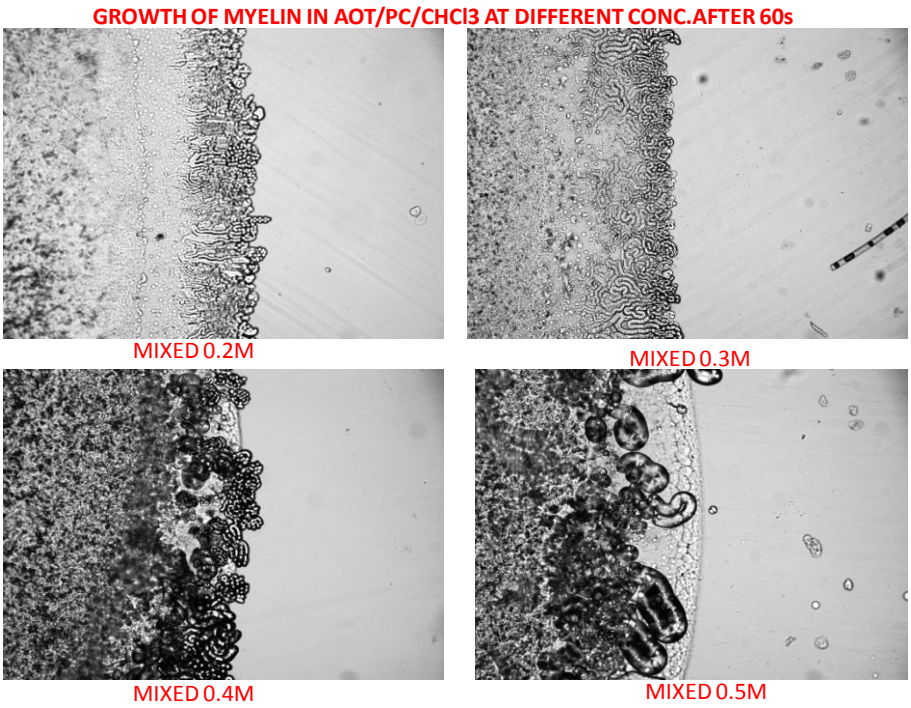

Fig. 3: Myelin growth after 60 s at different conc. of mixed system

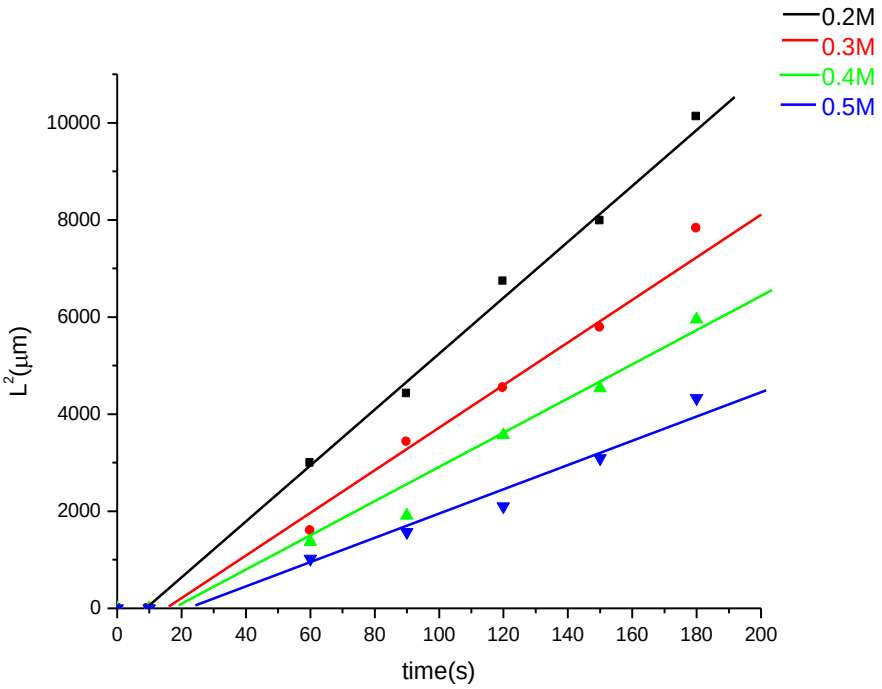

Fig. 4: Plot of L^2 vs time for different concentration of mixed AOT/PC/H_2O system

We have observed that concentration of the surfactant is affecting myelin growth. With increase in concentration rate is decreasing. When compared to single system, the myelin growth is slower in mixed system and the period of initial delay is also high ranging from 10-25 seconds.

CONCLUSION

We have studied the formation and growth of myelin using AOT/PC/$CHCl_3$ mixed surfactant system. It is found that, in comparison to individual system the growth of myelin is slower in mixed system. The growth curve of myelin of mixed system is approximately linear like that of the individual system.

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